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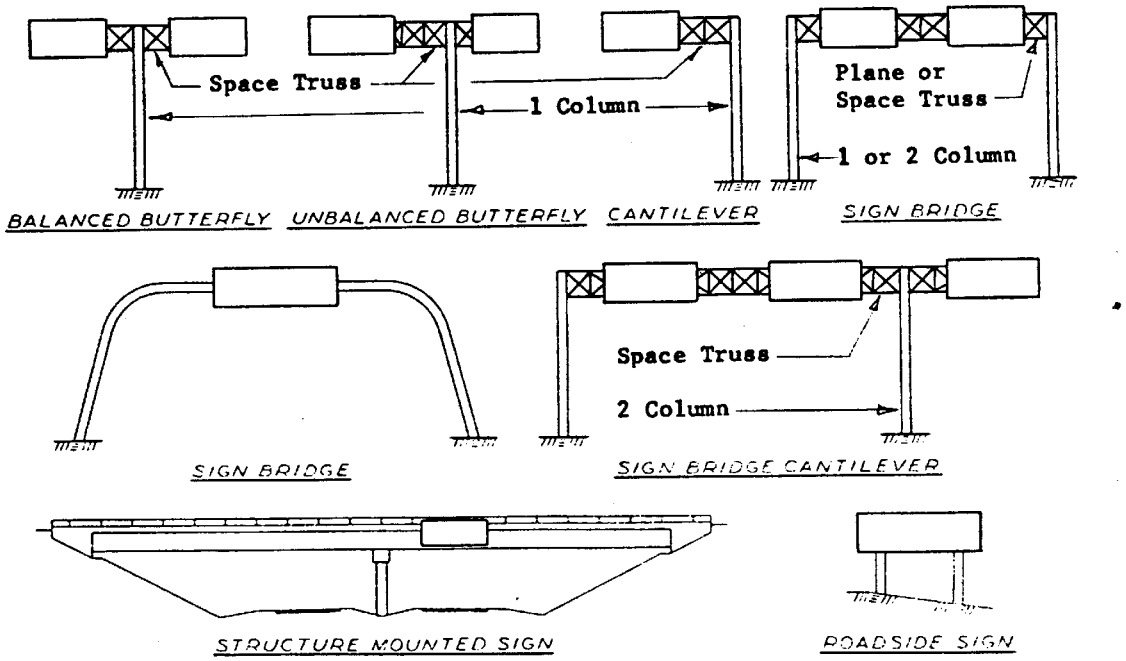
39.1 GENERAL

Signing is an integral part of the highway plan and as such is developed with the roadway and bridge design. Aesthetic as well as functional considerations are essential to sign structure design. Supporting sign structures should exhibit clean, light, simple lines which do not distract the motorist or obstruct his view of the highway. In special situations sign panels may be supported on existing or proposed grade separation structures in lieu of an overhead sign support. Aesthetically this is not objectionable if the sign does not extend below the girders or above the top of the parapet railing. Some of the more common sign support structures are shown in the following figure.



SIGN SUPPORT STRUCTURES

A. Signs on Roadway

Roadside or plane truss sign supports are located behind existing or planned guardrail as far as practical from the roadway out of the likely path of an errant vehicle. If roadside signs are located within the 30' (9 m) corridor, break-away sign supports are detailed. Wisconsin has experienced that the upper hinge on ground mounted signs with break-away supports does not work and it is not used. Since FHWA has not approved this removal, the hinge is used on all federal projects. All overhead sign-column type supports are located at the edge of shoulder adjacent to traveled roadway or placed behind barrier type guardrail.

Overhead sign bridges are to have a minimum vertical clearance of 18' (5.49 m) above the roadway. The minimum vertical clearance is set slightly above the clearance line of the overpass structure for signs attached to existing structures.

B. Signs on Bridges

Span deflections of the superstructure due to vehicle traffic are felt in sign bridge structures mounted on those bridges. The amount and duration of sign bridge deflections is dependent on the stiffness of the girder and deck superstructure, the location of the sign on the bridge, and the ability of the sign structure to dampen those vibrations out to name a few. These vibrations are not easily accounted for in design and are quite variable in nature. For these reasons, the practice of locating sign bridges on to bridge structures should be avoided when ever possible.

The following general guidance is given for those instances where locating a sign structure onto a bridge structure is unavoidable due to the length of the bridge on a safety need to guide the traveling public to upcoming ramp exits or into specific lanes on the bridge.

(1) Locate the structure support bases at pier locations.
(2) Build the sign bridge base off the top of the pier cap.
(3) Provide set back of the upright support of the sign bridge behind the face of parapet to preclude snagging of any vehicle brushing with that parapet.
(4) Use single pole sign supports (equal balanced butterfly's) in lieu of cantilevered (with an arm on only one side of the vertical support) sign supports.
(5) Consider the use of a Stockbridge type damper in the horizontal truss of these structures.
(6) Do not straddle the pier leaving one support on the pier and one support off the pier in the case of skewed substructure units for full span sign bridges.

39.2 SPECIFICATIONS AND STANDARDS

Reference specifications for sign structures are as follows:

AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals"

AASHTO "Standard Specifications for Highway Bridges"

State of Wisconsin "Standard Specifications for Highway and Structure Construction"

ASTM "Standards of the American Society for Testing and Materials"

Standard design data and details for break-away sign supports and sign bridges are given on Standards 39.1 through 39.13.

39.3 DESIGN CONSIDERATIONS

Supports for roadside signs are of two types depending upon the size of the sign to be supported. For small signs, the column supports are treated timber embedded in the ground. For large signs, the columns are galvanized or weathered steel supported on cylindrical concrete footings. Currently, all steel column supports for roadside signs are designed to break-away upon impact.

The following design data is employed for designing ground mount or roadside sign supports as given on Standard 39.1:

Wind Velocity = 75 mph (121 kph) Based on the fastest mile wind speed map and its corresponding methods to find wind pressure.

Wind Components: Normal = 1.0

Transverse = 0.0

Ice Load = 3 psf (144 Pa)

Group Loads	% of Allowable Stress
I Dead	100
II Dead + Wind	140
III Dead + Ice + (1/2 Wind)*	140

* Minimum Wind Load = 25 psf (1.2 kPa)

Allowable Soil Pressure = 3 ksf (4 kPa)

Wind loading is applied to the area of sign and supporting members.

Ice loading is applied to one face of the sign and around the surface of supporting members.

Sign structures for support of overhead signs are to be either a single column cantilever or butterfly or a space truss sign bridge supported by one or two columns at each end. For cantilever sign structures, the footing is a single cylindrical shaft with 'vanes' to prevent the overturning and twisting of the structure. For space trusses having one or two columns on an end, the footing is composed of two cylindrical caissons connected by a concrete cross-girder. The top surface of concrete foundations for all single plane trusses and sign bridges is to be 3' (915 mm) above ground line.

The following design data is employed for designing steel sign bridges as given on Standards 39.2 through 39.13.

| Wind Velocity = 90 mph (137 kph) Based on the 3-second gust wind speed
| map and its corresponding methods to find wind pressure.

Wind Components	Normal	Transverse
Combination 1	1.0	0.2
Combination 2	0.6	0.3

Dead Load = Wt. of Sign, supporting structure and lights.

Ice Load = 3 psf (144 Pa) to one face of sign and around surface of members.

Group Loads	% of Allowable Stress
I Dead	100
II Dead + Wind	133
III Dead + Ice + (1/2 Wind)*	133
IV Fatigue	**

* Minimum Wind Load = 25 psf (1.2 kPa)

| ** See Fatigue section of AASHTO for fatigue loads and stress range
| limits.

| Overhead cantilevered sign structures (four chord structures carrying Type I signage) are classified, for purposes of fatigue design, as Category 1 structures. These cantilevered support structures are designed to resist Natural Wind Gust and Truck-Induced Gust wind effects. Four chord cantilevered sign supports carrying Type 1 signage are not designed for Galloping wind effects due to the substantial stiffness and satisfactory performance history in this state.

Aluminum sign bridges are currently not being designed for new structures. Rehabilitation and repair type work may require use of aluminum members and shall be allowed in these limited instances. The following guidelines apply to aluminum structures in the event of repair and rehabilitation type work.

Aluminum sign bridge trusses are designed and fabricated from tubular shapes shop welded together in sections. The minimum thickness of truss chords is 1/4" (6 mm) and the minimum outside diameter is 4" (100 mm). The recommended minimum ratios of "d/D" between the outside diameters "d" of the web members and "D" of chord members is 0.4. A cast aluminum base plate is required to connect the aluminum columns to the anchor bolts.

AASHTO Specifications require damping or energy absorbing devices on aluminum overhead sign support structures to prevent vibrations from causing fatigue failures. Damping devices are required before and after the sign panels are erected on all sign bridges. Stock-bridge type dampers are recommended.

Steel overhead sign bridge trusses are designed and fabricated from tubular shapes for chords and angle shapes for web members. The minimum thickness of steel web members is 3/16" (4.8 mm) and .216" (5.5 mm) for chord members. The connections of web members to chords are designed for bolting or shop welding to allow the contractor the option to either galvanize individual members or complete truss sections after fabrication. The columns are steel pipe sections. Steel base plates are used for anchor bolt support attachment.

Steel cantilever sign bridges are designed and fabricated from tubular shapes for chords and angle shapes for web members. The minimum thickness for the members is indicated on the steel cantilever standard sheet.

When butt welding box sections, a back-up plate is required since the plates can only be welded from one side. The plate must be of adequate width for film to be used during weld inspection. The exposed weld is ground smooth for appearance as well as fatigue.

Signs are attached to sign bridge trusses at the time of erection. If the signs are not available, blanks are attached to a minimum of one-fourth the truss length near its center. The minimum depth of the blanks is equal to the truss depth plus 24" (610 mm). The blanks are to project an equal distance beyond the top and bottom chord members.

Provision can be made during the design of sign bridges for lighting of signs either at the time of installation or at a future date. Brackets for maintenance of light units are required to support a 2'-3 (686 mm) wide catwalk grating and a collapsible handrail. Brackets and handrailing are fabricated from aluminum. Catwalk grating and toe plates are fabricated from steel and galvanized.

Contract plans should note on them (under the general notes) if a hand hole is required on the upright of the sign bridge.

Design of all Sign Bridge structures should reflect some provision for the possibility of adding signs in the future (additional sign area). Consideration should include the number of lanes, possible widening of roadway into the median or shoulder areas, and use of diagrammatic signs to name a few. The truss design should reflect sizing the chords for maximum force at the center of the span. The design of the upright and truss webs should allow for signs being placed (say sometime in the future) more skewed to one side than the other. Uprights should be selected the same size

(outside diameter x thickness) for each side and the design shall reflect different lengths on either side as required by site conditions.

39.4 STRUCTURE SELECTION GUIDELINES

Sign bridges required for "small" traffic direction type signs (typically 2'-6 x 3'-0 deep or 3'-0 x 4'-0 deep or small informational type signs up to 6'-0 in depth) usually can be accommodated by cantilever or overhead monotube type structures. The horizontal and vertical members are usually tapered round pipe and tube sections. Cantilever structures usually accommodate up to approximately 70 sq. ft. of sign area on cantilevers with arms from 15 to 40 feet in length and a maximum sign depth of about 6 feet due to limitations of bracket hardware holding a deep sign on the single arm member. Overhead monotubes (uprights on each span end) can accommodate up to approximately 230 sq. ft. typically on spans ranging from 40 to approximately 80 feet in length with a maximum sign depth of about 6 feet. Monotube sign structures are fabricator designed. State contract plans must provide essential data for the fabricator to size the structure from. The structure is typically depicted on the State Contract plans with a line diagram showing the structure span, sign sizes and location, relative difference in elevation between the high point of roadway and the ground elevation at the vertical support(s) as well as the required minimum vertical clearance. Any unusual design criteria must be provided on the state contract plans (a heavier than normal sign or large coefficient of height factor for the site to name a couple of examples). A footing design needs to accommodate the structure loading and anchor bolt circle of the monotube sign structure. The smaller monotube sign supports are bid as Overhead Sign Supports. Design criteria and footing base design is described in the State of Wisconsin Standard Specifications for Highway and Structure Construction.

Structures which carry sign areas and depths greater than those limitations described above are generally going to be larger structures requiring an arrangement of chords and web members in the form of a truss for the horizontal portion of the structure. The State Contract plans provide structural details in this instance. Chapter 39 sign bridge standards provide details for 4 chord systems.

WisDOT structures shown in Chapter 39 are intended for use with common Type 1 signage (reflective backing on aluminum extrusions). Structures carrying other types of signs (Variable Message Signs for example) require special consideration and may require special consideration and may require modification to those details. Special concerns include:

1. Weight of the sign panel.
2. Width and weight of catwalk.
3. Consideration of wind effects unique to these signs.
4. Modification to brackets used .

Wisconsin has allowed use of the Minnesota 4 chord configuration providing that the Designer check the design for their particular structure.